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ABSTRACT

Described in this guide are the techniques used in a mathematics anxiety treatment project. All eighth- and tenth-grade students in two junior high schools and two high schools in a large urban school district were evaluated to determine their "math-anxiety" and "math-achievement" levels. Forty-five junior high and 45 high school girls were selected from this large pool of students. These 90 young women participated in a 6-week, 12-lesson project designed to reduce anxiety and improve attitudes toward and achievement in mathematics. The approach to mathematics-anxious girls was: (1) help them know when they are nervous and help them identify precise experiences that make them nervous; (2) give them specific tools to counteract irrational fears; (3) provide them with interesting experiences in basic mathematical operations; and (4) instill in them an understanding of the wide variety of mental activities encompassed in the word "mathematics." The overall aim was to show these students that mathematics is an integral part of their lives and does not have to be intimidating. (PK)

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# A MINDSET FOR MATH

## Techniques for Identifying and Working with Math-Anxious Girls


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Columbus, Ohio

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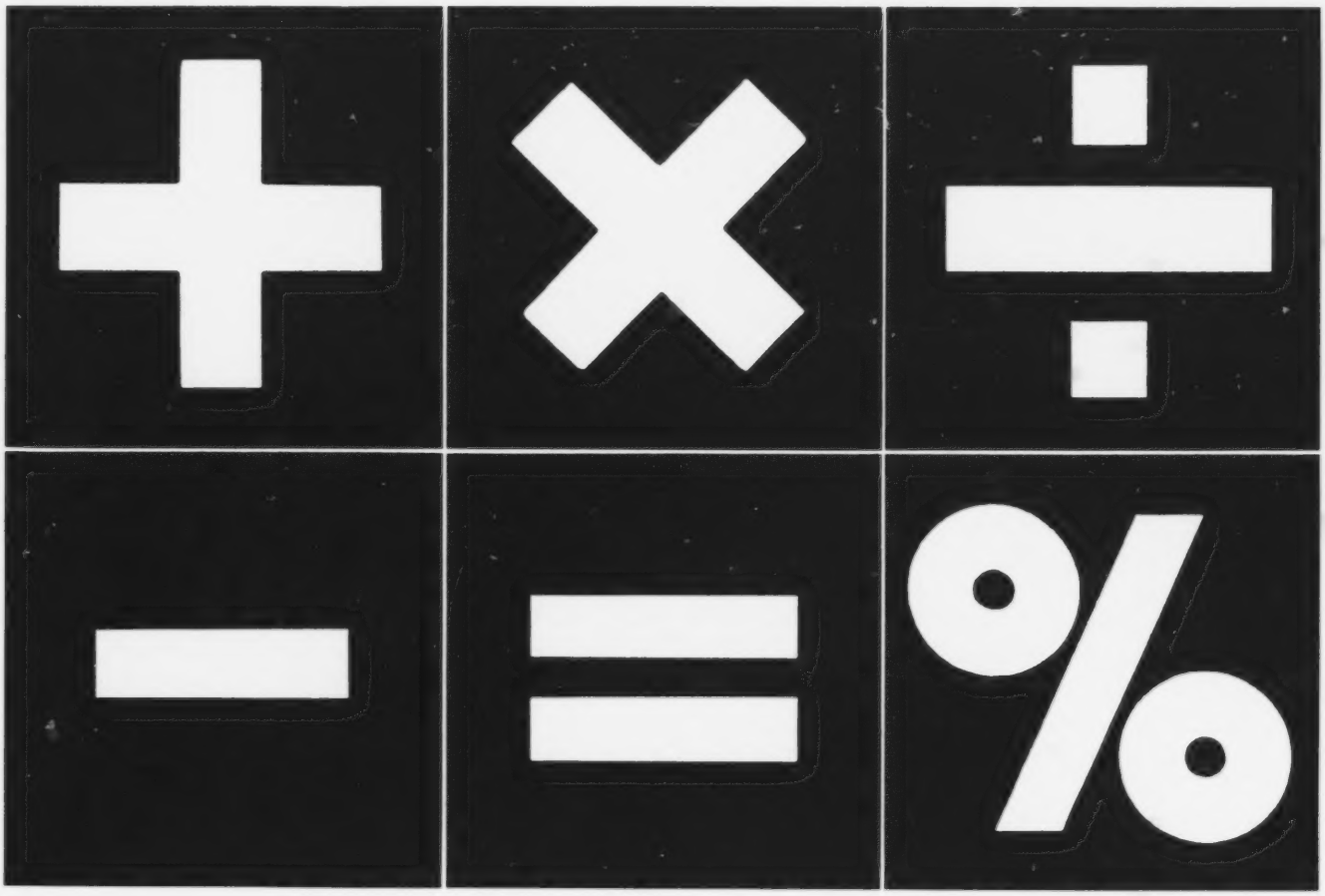


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# INTRODUCTION

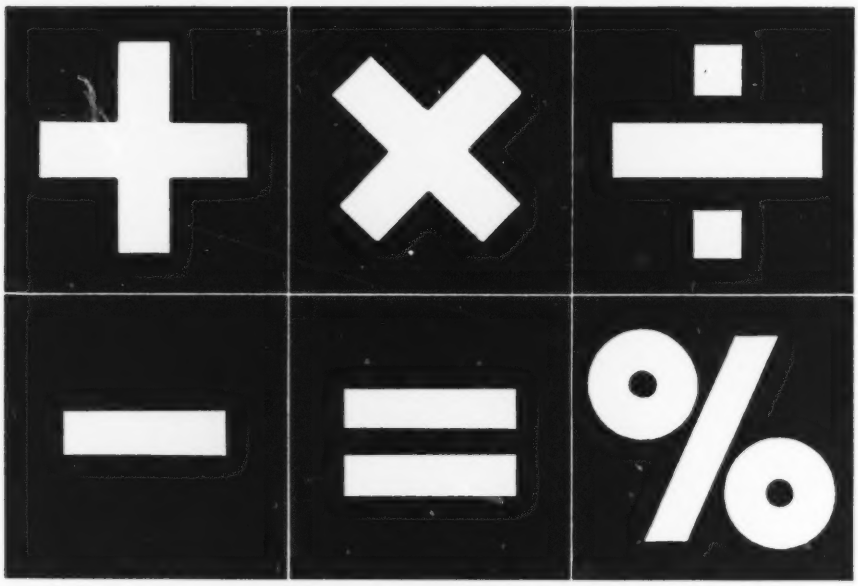
Math anxiety has been defined as an unspecified fear related to a mathematical experience. Girls, especially, seem to be affected by this anxiety, as shown by their underrepresentation in math-related careers (Fennema and Sherman 1977). Many students with the ability to do well in math continue to avoid it in school.

What techniques can be used to alleviate this anxiety and open doors to new career possibilities? How can students, especially young women of junior high and high school age, develop more positive feelings about their mathematical capabilities?

Described in this guide are the techniques used in a math-anxiety treatment project. All eighth- and tenth-grade students in two junior high schools and two high schools in a large urban school district were evaluated to determine their math-anxiety and math-achievement levels. Forty-five junior high and forty-five high school girls were selected from this large pool of students. These ninety young women participated in a six-week, twelve-lesson project designed to reduce anxiety and improve attitudes toward and achievement in mathematics.

Our approach to math-anxious girls was (a) help them know when they are nervous and identify precise experiences that make them nervous, (b) give them specific tools to counteract irrational fears, (c) provide them with interesting experiences in basic mathematical operations, and (d) instill in them an understanding of the wide variety of mental activities encompassed in the word "mathematics." The overall aim was to show these students that mathematics is an integral part of their lives and does not have to be intimidating.

# HOW TO IDENTIFY MATH-ANXIOUS FEMALE STUDENTS



**Math gives me the shakes.**

## IDENTIFYING MATH-ANXIOUS GIRLS: THE FOUR-STEP PROCESS

1. **STOP AND READ RECORDS.** Patterns to notice are:

   standardized scores indicating above-average ability coupled with grades below average*

   students with good math ability who avoid advanced placement or enriched classes

   written teacher comments that suggest a student has an ability-achievement gap

2. **LOOK CAREFULLY.** Some signs of anxiety are:

   rarely volunteering

   sitting in the back of the room

   evidencing a combination of good homework but poor test results**

3. **LISTEN.** Pay attention to students' comments and conversations

4. **DO SOME QUICK SCREENINGS.** Two samples of screenings that you could use are the Math Thermometer and a Preference Pattern Rating system. These are shown on the next pages.

---

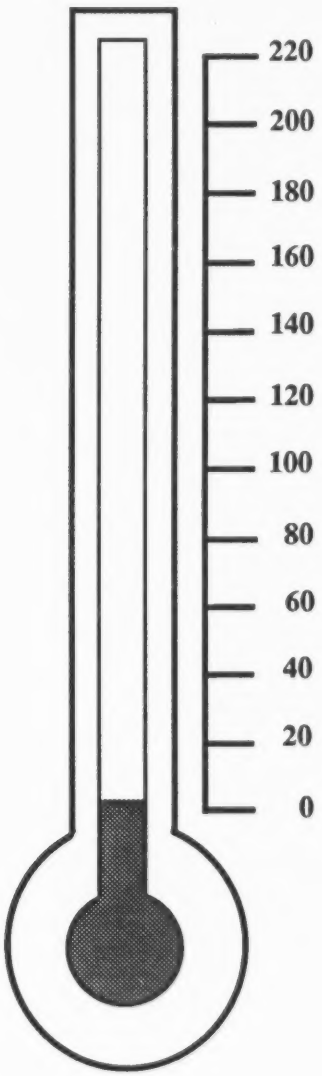
**However, math-anxious students may do poorly on standardized mathematics tests as well as in class.*

***A pattern of good homework and poor tests may also suggest **test** anxiety rather than **math** anxiety.*

Student

# MATH THERMOMETER

**Directions:** We want to know how nervous you get when you do math. You will use the thermometer on this page to tell us how nervous you feel. Fill in the thermometer to tell us how nervous you feel, like this: If you are not nervous at all, draw a line at the 0-degree position. If you are very nervous, draw a line at the 212 degree position. Use the numbers in between for other choices.



Student

## PREFERENCE PATTERN RATING

**Directions:** Listed below are seven subjects--English, Science, Health, Mathematics, Music, Physical Education, and Social Studies. Write 1 next to the subject you like the most, 2 next to the one you like second best, 3 next to the one you like less, etc., until there is a 7 next to the one you like least.*

Please rank the subjects as follows:

1 2 3 4 5 6 7

(Like the most) (Like the least)

English _____

Science _____

Health _____

Mathematics _____

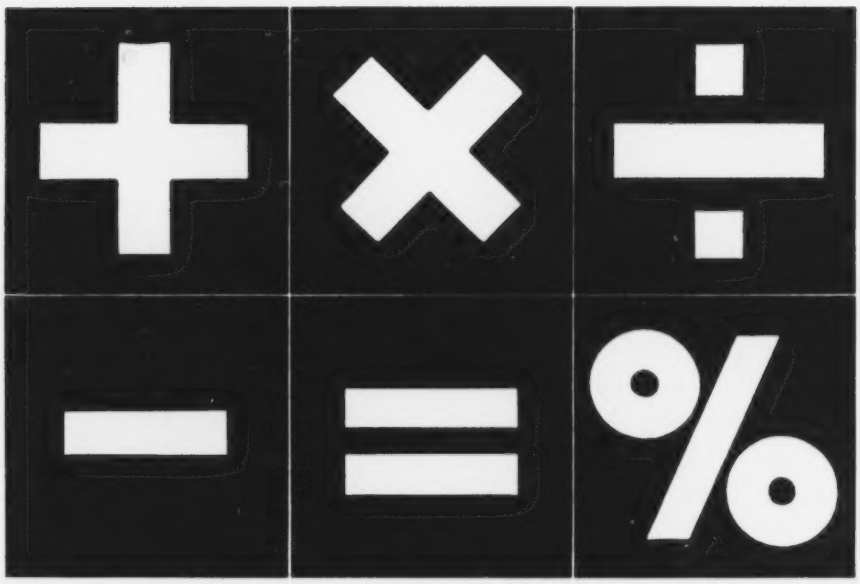
Music _____

Physical Education _____

Social Studies _____

*You might find it appropriate to substitute other subjects, or to delete from or add to the list.

# TO THINE OWN SELF BE SENSITIVE: SELF-INSTRUCTION ACTIVITIES



**Math makes my hands sweat.**

# INTRODUCTION

Girls who feel they don't now and never will understand math tend to avoid math courses as early as possible in their school careers. When faced with unavoidable math tasks, these students approach them with a variety of negative emotions, ranging from passivity to panic. These negative emotions and their accompanying tension, fear, and anxiety affect the body and mind in ways that vary from person to person. Fearful thoughts or silent, internal conversations have an impact on how these students feel and how they act.

Students can learn to talk to themselves positively, to tell themselves things that decrease their nervousness rather than escalating anxiety. The first step is to recognize the body's messages; the second step is to counteract and control them.

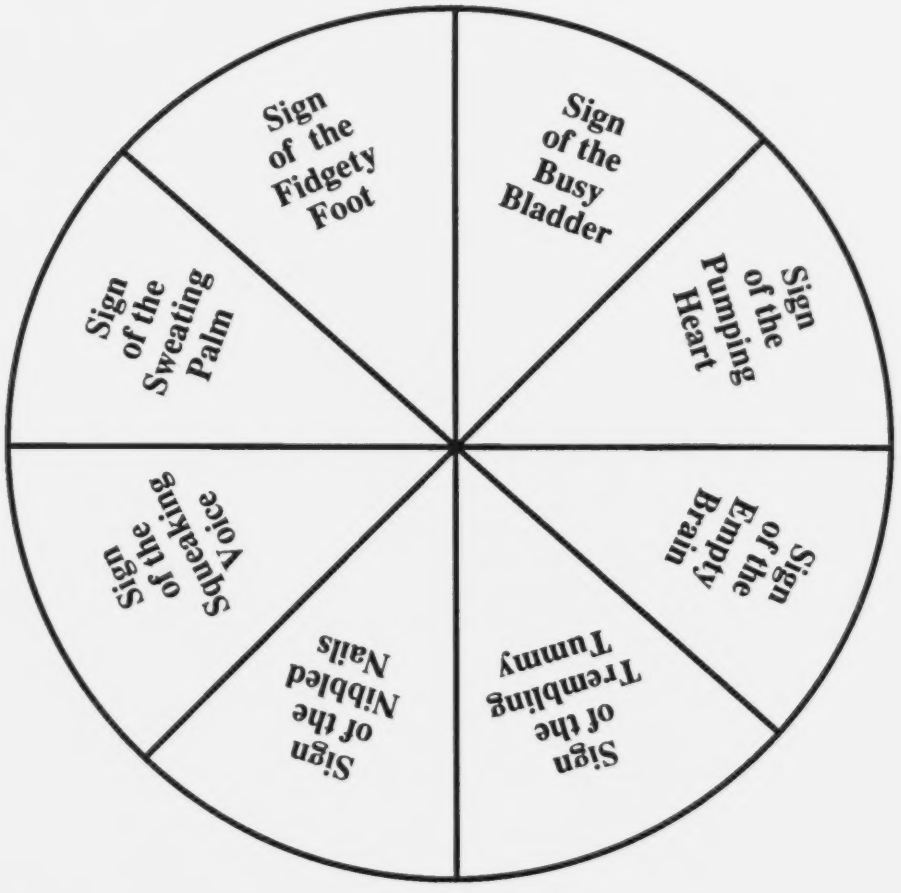
On the following pages are some suggestions for the "re-education" of your math-anxious students.

## ACTIVITY 1: HORRORSCOPE

Recognize the signs. Ask the students: How do you know when you are nervous? What physical, mental and emotional hints are there?

Student discussion of these questions will probably elicit many of the physical, mental, and emotional aspects of life under stress that are diagrammed in the sample "Horrorscope": pounding heartbeat, profuse sweating, nervous mannerisms, upset stomach, and forgetfulness.

Sample Horrorscope: Use when there is a mathematical challenge in your future!

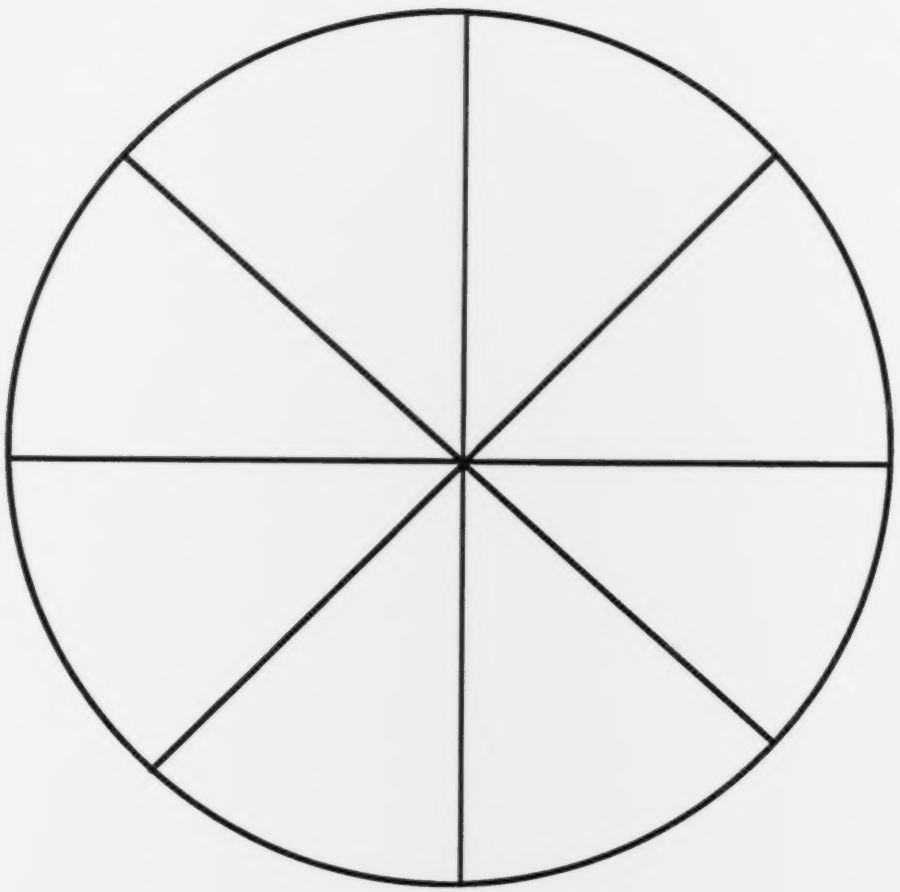

Sign of the Busy Bladder
Sign of the Pumping Heart
Sign of the Empty Brain
Sign of the Trembling Tummy
Sign of the Nibbled Nails
Sign of the Squeaking Voice
Sign of the Sweating Palm
Sign of the Fidgety Foot

Encourage your students to fill out their own Horrorscope as shown on the next page, or have them design some other tool to chart personal signs of anxiety.

Student

# HORRORSCOPE

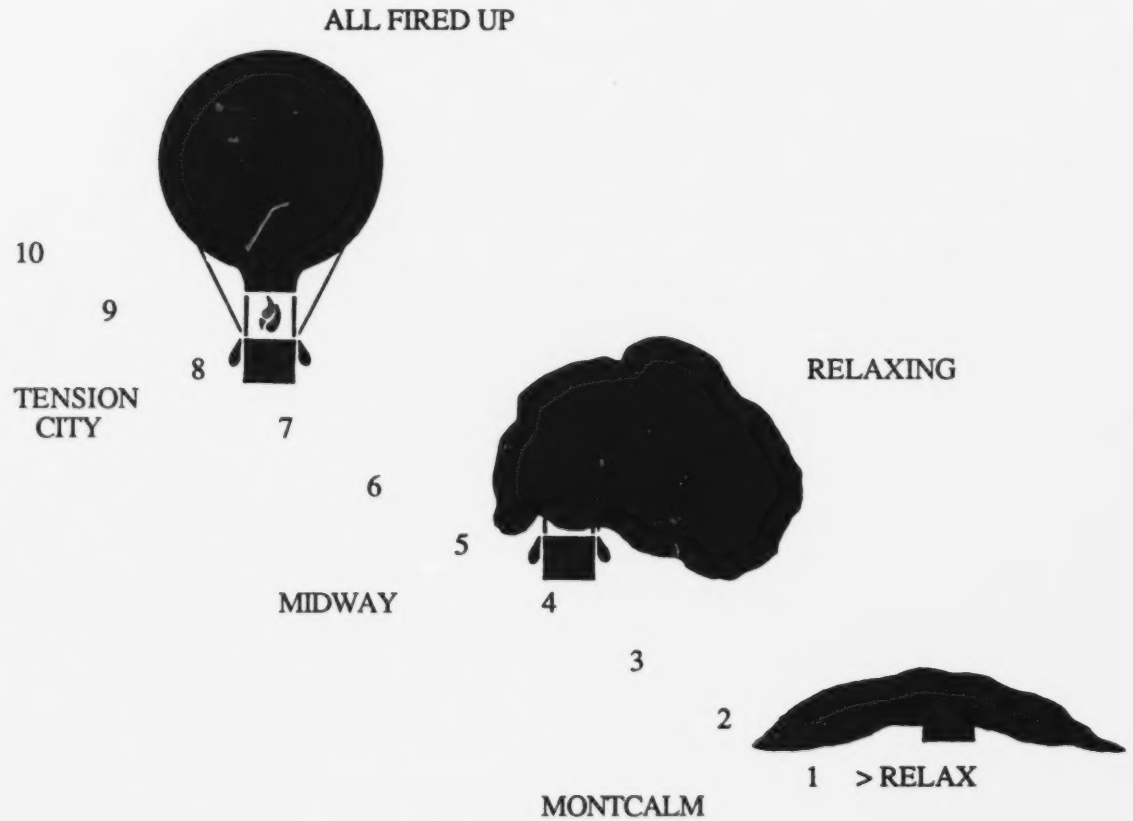
**Directions:** Make your own Horrorscope of messages that your body sends you on special delivery.



## ACTIVITY 2: A FREE TRIP FROM TENSION CITY TO MONTCALM

Now that you have helped your students know what happens when they feel nervous, anxious, and tense, it is time to discover the particular persons, places, and things that affect a student's nervous system.

Ask each student to make a list of ten situations in which she feels upset. The list may include anything, such as going to school, doing homework, visiting the dentist, meeting a member of the opposite sex, making a speech, or dividing fractions. Or, you could ask students to keep a log of nervous-making situations that occur during a one-week period. This activity will help students begin to acknowledge their fears--the first step in the process of confronting them. You may want to use an illustration similar to the one below, perhaps drawing it on the board, during this activity.



## ACTIVITY 3: ENERGIZERS OR ENERVATORS?

Are your students ones who like The Little Engine That Could?:

See a mountain ahead and keep right on moving?

**or**

See a mountain ahead and run out of steam?

Here are some "out of steam" statements you might have heard:

1. *Oh, I never could do Math!*
2. *Numbers just seem like doodling to me.*
3. *Everybody knows girls can't do math.*

Here are some statements that might help these students get to the other side of the mountain:

1. *If I think clearly about this problem, I can understand it.*
2. *It's really fun when I figure out how math works!*
3. *Girls can do math just as well as boys.*

Use the next page to have students make up personal lists of possible self-talk statements.

Student

## SELF-TALK MATH STATEMENTS

### NEGATIVES

On this side, write some things you say to yourself that show:

Gloom and doom

_____
_____
_____

Fatigue and exhaustion

_____
_____
_____

Woe and misery

_____
_____
_____

Despair and agony

_____
_____
_____

Pity and pain

_____
_____
_____

### POSITIVES

And on this side, write down what you could say to yourself instead

Happiness and cheer

_____
_____
_____

Pep and energy

_____
_____
_____

Hope and faith

_____
_____
_____

Joy and health

_____
_____
_____

Optimism and vitality

_____
_____
_____

## ACTIVITY 4: PRACTICE MAKES PERFECT

Now that you have helped your students know how "nervous" feels and what makes them feel nervous, use this prescription to cure (or at least reduce) their tension. Yes, they **can** learn to control their body.

RULES FOR THE ROAD TO RELAXATION

**First, get comfortable.** Take off your shoes, close your eyes, lean back.

**Second, become sensitive to your body.** Try to feel your heartbeat. Listen to your heartbeat. Notice your eyes blinking. Notice how heavy the lids feel. Feel your chest expand and contract as you breathe . . . hear the sound the air makes going in and out . . . feel the departure of the air, as it goes in and out.

**Third, inhale through your nose to a count of four.** Exhale through your mouth to a count of eight. Repeat this three times. (No giggling, except the first time!)

**Fourth, take a trip through your body.** Have someone with a soft and gentle voice lead you on a trip through all the unnoticed tight and tense parts of your body by saying quietly: "Pay attention to your toes. Relax your toes. Pay attention to your ankles. Relax your ankles." Really try to concentrate on each part of your body to get rid of the tension.

**Fifth, visualize a perfect spot.** It might be a room, the seashore, a cool forest. Imagine yourself in this place as you continue your relaxation practice.

**Sixth, practice this routine for getting rid of tension.** It feels good! You have practiced enough when the relaxation process becomes almost instantaneous.

Remind students that they don't have to learn all these relaxation techniques at once. They should take their time--that's part of relaxation!

You can talk students through the exercise, or you can find a tape at your local bookstore, complete with ocean sounds, classical music, or a soothing voice telling them what to do. You can even make your own tape.

## ACTIVITY 5: STARRING ROLES

One of the most successful techniques for defusing tension is rehearsal. Practicing responses **before** a nerve-racking scene develops can often prevent increased fear and embarrassment when the dreaded situation occurs. Prepare to roll the cameras as the "stars"--your students--act in a series of Dreadful Situations!

POSSIBLE SCENARIOS

1. You are in class and the teacher asks you to read your essay to the group.

   TAKE ONE. Dramatize your worst possible solution and behavior: You feel embarrassed. Your face gets red. You stumble over the words and can't decipher your own writing. You drop your papers and bang your head as you pick them up. You cry.

   TAKE TWO. Dramatize your best possible solution and behavior: You feel embarrassed. Your face starts to get red, but you recognize what is happening. You think of your favorite spot to be; you relax your shoulders; you take a deep breath, smile, and read your essay to the applause of the class.

2. You are riding your bike on a country road and you hear air leaking out of **both** tires.

3. You are studying for a math test and your girlfriend calls and asks you to go shopping with her.

Practice all the situations you listed before as those which make you anxious. Use your relaxation techniques to master your feelings.

Student

# DREADFUL SITUATIONS

POSSIBLE SCENARIOS

1. You are in class and the teacher asks you to read your essay to the group.

   TAKE ONE. Dramatize your worst possible solution and behavior: You feel embarrassed. Your face gets red. You stumble over the words and can't decipher your own writing. You drop your papers and bang your head as you pick them up. You cry.

   TAKE TWO. Dramatize your best possible solution and behavior: You feel embarrassed. Your face starts to get red, but you recognize what is happening. You think of your favorite spot to be; you relax your shoulders; you take a deep breath, smile, and read your essay to the applause of the class.

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3. You are studying for a math test and your girlfriend calls and asks you to go shopping with her.

Practice all the situations you listed before as those which make you anxious. Use your relaxation techniques to master your feelings.

Student

## MASTER OF RELAXATION ARTS

Fill in this diploma when you have become a Master of Relaxation Arts. It certifies that you are carrying inside yourself the skill to put yourself at ease in any situation.

***THIS DIPLOMA CERTIFIES THAT***

_____

***HAS COMPLETED ALL THE***

***REQUIREMENTS FOR THE DEGREE OF***

***MASTER OF RELAXATION ARTS***

***WITH ALL THE RIGHTS AND***

***PRIVILEGES GRANTED BY***

***THIS ACCOMPLISHMENT***

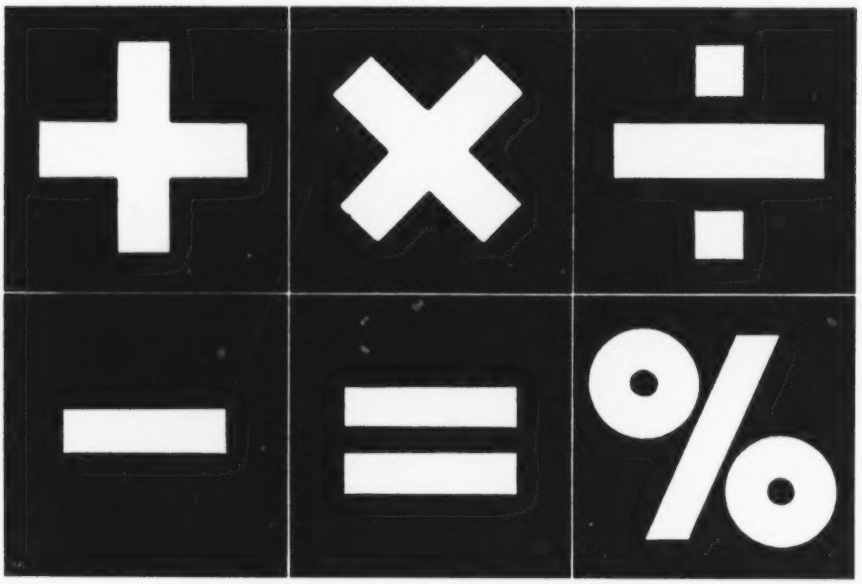
_____

***DATE***

_____

***WITNESS***

# AT THE HEART OF THE MATTER: MATH ACTIVITIES



**I'm actually passing math.**
**It was my worst subject.**

# INTRODUCTION

How do you decide what math activities should be used to reduce student anxiety?

- Do you drill in basic facts?
- Do you challenge students with sophisticated material?
- Do you present "real life" math that focuses on budgeting, bill paying, taxes, and insurance?
- Do you use hands-on or worksheet materials?

Your knowledge of your students will determine which direction or combination of directions will be most effective. However, most math-anxious students do not understand that math is far more than basic number operations; it is founded on simple, logical principles that are embedded in everything we do and everything we see and touch.

Student anxiety seems to arise when universally shared observations and experience are isolated and quantified to form concepts. In the switch from concrete to abstract, students lose touch with the origin of the ideas. The math projects we selected to re-form our students' ideas about math were designed to emphasize the presence of mathematical concepts in the total environment.

## ACTIVITY 1: HAVE A LAUGH-- DON'T BE AFRAID OF DECIMALS

A first step in reducing math anxiety is to destroy the stereotype of math as a super-serious subject. Here is a simple exercise that is sure to add an air of light heartedness to the most anxiety-ridden group.

Many students have difficulty learning to differentiate between whole-number and decimal-number pronunciations. (Learning this distinction may be the only time a student can legitimately stick her tongue out at the teacher!) Correctly enunciating the decimal-distinctive "th" sound requires placing the tongue between the teeth and exhaling. A slight exaggeration of the procedure leads to a highly therapeutic mathematical exercise.

The role of the teacher in this lesson is simple. Maintain a poker face and insist on vigorous practice!

Whole number: Say "ten."

Decimal number: Say "ten" and put your tongue between your teeth and blow.

Presto--you have "tenth."

One more time, please: Say TEN

Stick that tongue w-a-y out: TEN -TH

Say "hundred": HUNDRED

Stick that tongue w-a-y out: HUNDRED - TH

Say "thousand": THOUSAND

Stick that tongue w-a-y out: THOUSAND - TH

## ACTIVITY 2: MATH IS ALL AROUND YOU

Once students are relaxed and know that learning math can involve silliness as well as studiousness, begin to develop students' sensitivity to their mathematical environment. Like the great detectives, develop investigative techniques and find mathematical symbols and concepts in as many different places as you can. Try for some unusual sources. Here are a few obvious ones for a start:

ON THE HOME FRONT

| | |
|---|---|
| Geometric Shapes: | doorways, floor tiles, windows, wallpaper |
| Scales: | thermometers, oven dials, microwave panels |
| Fractions: | recipes, measuring spoons, cups |

ON THE SCHOOL FRONT

| | |
|---|---|
| Arithmetic operations: | how many books in a set; daily, weekly, and yearly attendance counts; lunch count, lunch prices |
| Time order: | dates in history; ordinal numbers: 32nd President; B.C. or A.D. |
| Geometric shapes: | pictures of the Washington Monument (obelisk), famous cathedrals (Gothic arches) |
| Speed and distance: | traveling craft such as the space shuttle, trains, boats, autos, or trucks that appear in reading and current events materials |
| Vital statistics: | from any reading book--look for age of characters; when they lived; how much they ate; their height, weight, eye and hair color, or personality traits |

Mathematical quantities and ideas are found throughout recreational reading books. For instance, characters in a book could be:

1. counted
2. divided into categories such as
    a. alive throughout - dead by the end
    b. male, female, animal
    c. old, young
    d. good, bad
    e. urban, suburban, rural

3. placed along a continuum and categorized into areas listed above such as c, d, or f.

4. rated for importance in the book

5. described quantitatively or modeled using quantitative descriptions.

And descriptions of the setting or settings in a book could be used to:

1. estimate latitude and longitude of the setting

2. suggest range of temperatures in each season

3. estimate height of mountains, size of bodies of water, and other figures related to geography

4. create a map showing relationships between settings

5. create a scale model of an important building, town, or city prominent in the book.

Or activities of the characters could be examined to:

1. determine if they are influenced by mathematical concepts

2. determine if the activity could be improved by using mathematical concepts

3. determine what would happen if the means used for an activity were changed. For example, what would happen to the events in a story if the character had to hitch-hike instead of travel by plane, or by foot instead of automobile?

## ACTIVITY 3: WHAT'S IN A NAME?

Now that your students are realizing that they are already meeting and dealing with mathematical ideas in their daily environment and in their nonmathematical reading, they can begin to experiment with some unusual uses for numbers.

One use is in coding where the numbers have a particular relationship to each other. This relationship can be used to hide messages. The first messages should probably be in English, but if the students are studying a foreign language, there is no reason they could not experiment with codes in that language also.

Instruct students: Make up a code to go with the English alphabet. For example, an easy one is A = 1, B = 2 . . ., Z = 26. Write your first name and your family name using this code. Then try others, for instance, your school's name, your best friend's name, the name you wish you had, your teacher's name, the name you sometimes call the teacher, movie and TV stars, artists, authors, political and historical figures, and so on. An infinite number of coding systems can be developed, and experimenting with them is intriguing. However, there are other activities that stimulate some divergent mathematical thought.

After the relationship between numbers and letters is clearly understood and students have practiced simple and sophisticated coding methods, have students try some of these challenges:

1. Line up by first-name totals instead of by alphabetical order.

2. Spend a morning using numbers instead of names to designate one another.

3. Predict what names will have the largest total if the numbers are added up.

4. Find names that have the fewest letters and the greatest sums--or the opposite, the most letters and the smallest sums.

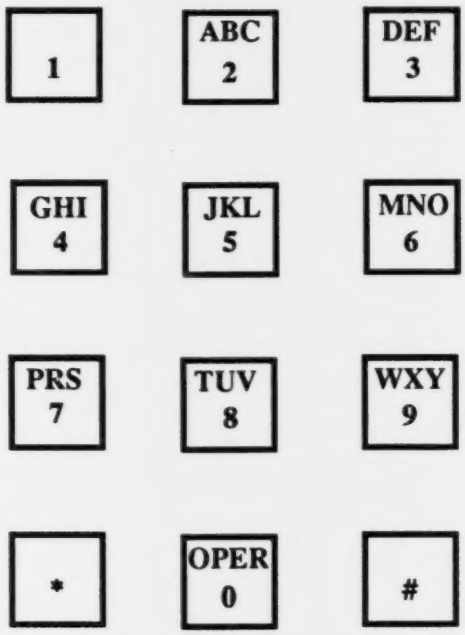
When your students are ready for greater challenges, divide them into teams and ask them to try to decipher the Secret Message on the next page.

Student

## SECRET CODE

Name_____ Team _____

**Directions**: This is an exercise in deciphering codes using the letters and numbers on an ordinary phone. You are probably already familiar with the layout:




For Q and Z, use 1. The zero can be used for the spaces between words. Remember, a numeral may stand for any of three letters. By keeping these number-letter combinations in mind and constantly revolving the letters, you can figure out the words and phrases.

#1 843730273066078537063027244832887303670202278530460843025683 7.

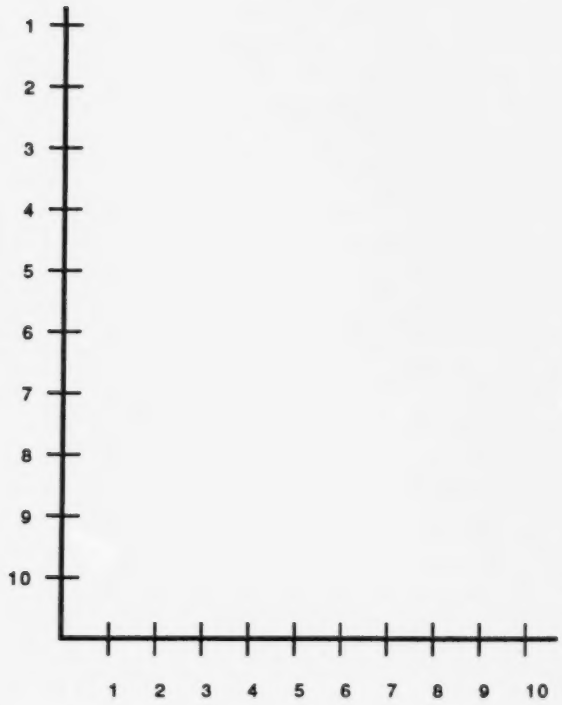
#2 626'703544480847684405433047054648330665902908430769370630447046244628466.

# ACTIVITY 4: THINGS ARE NOT WHAT THEY SEEM

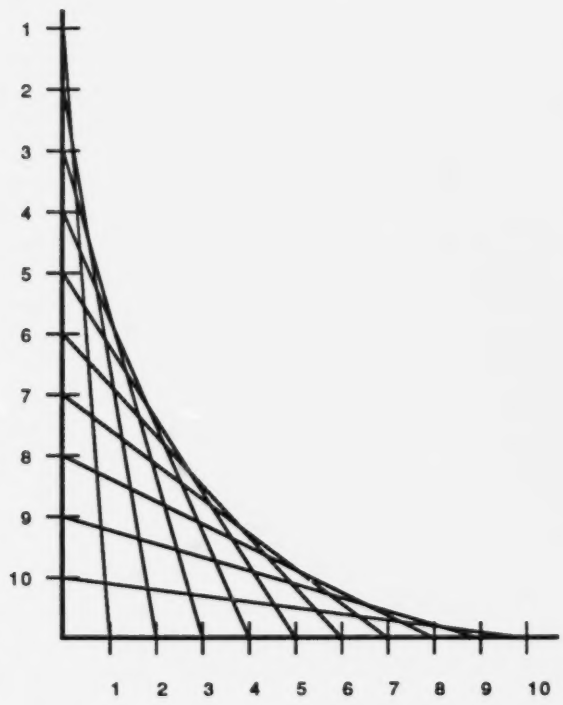
Mathematical concepts are not only intriguing and entertaining, but also surprising and aesthetic, that is, have a sense of beauty. One of the best activities that combines those four elements involves using straight lines to create beautiful curved designs. The equipment needed is simple--a pencil, a ruler, and graph paper.

## Directions

Begin by choosing an interval and numbering as shown.




Look at the example carefully to be sure you labeled the axes correctly. Now, connect 1 to 1, 2 to 2, 3 to 3, etc. And if you followed directions, your figure should look like this:




Variations are possible by adding intersecting axes, using colored pencils or pens, and varying the intervals on either axis or on both axes. Pins (at the points on the axes) and strings (instead of drawn lines) on cork, cardboard, or other materials make impressive 3-D effects.

Student

## ACTIVITY 5: PE(MD)(AS)

Over many years, mathematicians have found it necessary to establish some agreed-upon rules for the order of operations. Have you ever had a math problem for which you weren't sure what to do first?

For this math problem,

$(8 + 2) \times 3 - 4 =$

which is the right answer?

$(8 + 2) \times 3 - 4 = -10$

$(8 + 2) \times 3 - 4 = 10$

$(8 + 2) \times 3 - 4 = 26$

There is a simple way to solve this math problem correctly. All you have to do is remember **PE(MD)(AS)**. This is an acronym for the agreed-upon order of operations.

**P** stands for parentheses.
If there are any parentheses, solve what is inside them first.

$(8 + 2) = 10$

Now our math problem looks like this:

$10 \times 3 - 4 =$

**E** stands for exponents.
Since our problem has no exponents, we can move to the next step.

**M** stands for multiplication:

$10 \times 3 - 4 = 30 - 4 =$

**D** stands for division.
If M (multiplication) and D (division) are next to each other in the problem, do them in left-to-right order--M, then D or D,then M.
Our problem,

$30 - 4$

has no division, so we can move to the next step.

**A** stands for addition.
Since there is no addition, we can move to the next step.

*Continued*

**S** stands for subtraction.
If A and S are next to each other, do them in left to right order
A, then S or S, then A.

Our problem now is 30 - 4. When we subtract, we find that the answer is 26. So, using the order of operations, our answer to the problem

$$(8 + 2) \times 3 - 4 =$$

is 26.

**PE(MD)(AS)** might occur as **PE MD AS**
**PE DM AS**
**PE MD SA**
**PE DM SA**

## ACTIVITY 6: BODY LANGUAGE

You may think that mathematical concepts such as "root" or "perpendicular" can be properly explained only in a math book. Why not try a new approach? Dump essential words of math vocabulary into a paper bag. Ask a student to reach in and select a word and act it out. You may find some interesting interpretations as well as misunderstandings of words that you thought students understood last week.

> An imaginative student might hop about the room with arms overhead looking like large, floppy ears. Of course, that's **multiply**.
>
> Assuming a Muhammad Ali stance, another student might pretend to knock someone flat. Did you guess that the word is **power**?

Here are some commonly used words and their definitions for "math parlor games."

### MATH VOCABULARY LIST

| | |
|---|---|
| **circumference** | The distance around the outside of a circle ($\pi$ x diameter). |
| **cubed** | The number is raised to the third (3) power or is multiplied by itself three times. |
| **denominator** | The bottom part of a fraction. In the fraction 3/4, the denominator is 4. "D" for denominator or "down part." |
| **diameter** | The length of a straight line through the center of an object. |
| **difference** | The answer you get when you subtract. |
| **exponent** | In $2^3$, the 3 is the exponent. |
| **parallel** | Two or more lines that run side by side and never meet. |
| **perimeter** | The distance around the outside of a noncircular figure. |
| **perpendicular** | Two lines that meet at 90° angles. |
| **pi** | The Greek symbol $\pi$, which equals 22 ÷ 7, or 3.14. |
| **power** | The exponent. |
| **product** | The answer when you multiply. In 2 x 2 = 4, the product is 4. |
| **quotient** | The answer when you divide. In 12 ÷ 4 = 3, the quotient is 3. |
| **radius** | Half the diameter of a circle. |
| **reciprocal** | The answer when you divide on (1) by a number. Thus, 3/4 is the reciprocal of 4/3. |

| | |
|---|---|
| **right angle** | An angle of 90°, which is the angle between two lines that are perpendicular. |
| **root** | A number multiplied by itself the required number of times gives the number with which you began. For example, 4 is the square root of 16 ($\sqrt{16}$), because 4 x 4 = 16. The number 2 is the cube root of 8, because 2 x 2 x 2 = 8. |
| **sum** | The answer you obtain when you add. |

## ACTIVITY 7: FOOD FOR THOUGHT--JELLY BEAN MATH

**Needed**: A bag of colored jelly beans.

Have you ever wondered if there is any mathematical significance to a bag of jelly beans? The answer is an unequivocal yes. In fact, jelly beans are good for a myriad of math activities.

PREDICTION and ESTIMATION:

Hold up the bag of unopened jelly beans.

Questions
1. Can we assume that jelly beans are really in this package? Why?
2. Is such an assumption always possible?

Prediction
1. How many jelly beans are in the package?
2. How many colors are represented?
3. What are the colors?
4. How many of each color are in the package?

Procedure
1. Open the package.
2. Give each student a handful to count.
3. Write each student's total on board then have students add all numbers.

Question
1. Does every student have the same number of jelly beans?
2. What is the average number of jelly beans in a handful?
3. What is the least and what is the most number of jelly beans in a handful?
4. What is the average variance among the students' handful?
5. How close did the results of the total number in the package come to the prediction?

Procedure
1. Sort the jelly beans by colors.

Question
1. Does the package contain the same number of each color?
2. What is the average number of each color of jelly beans?
3. What is the least and most number of each color of jelly beans?
4. Are there any unusual deviations from the normal distribution?
5. How close were the results to the predictions?

Now, using an unopened bag of jelly beans, have students predict what its contents will be. How secure do students feel in making this prediction? Would they feel more secure if they had examined more bags of jelly beans? How much evidence is needed to make a good statistical prediction?

## ACTIVITY 8: JELLY BEAN FRACTION ACTION

Just as jelly beans are perfect materials for understanding statistical procedures like prediction and estimation, they are also perfect materials for understanding fractions.

**PROBLEM #A**

Procedure 1. Count all of the jelly beans in a package.
If there are 50, then 50/50 = 1 bag.

2. Separate the jelly beans into colors.

3. Count the number of each color.

4. Write the number of each color as a fraction of the whole:
If there are 8 red, then R - 8/50.
If there are 22 blue, then B = 22/50.
Write the fraction for each color.

5. Add up all of your fractions. Do they equal 50/50?

All the parts should equal the whole--1 bag of jelly beans.

**PROBLEM #B**

Procedure 1. Separate the jelly beans into colors.

2. Call each color group a whole:

R = 8/8
Y = 6/6
B = 25/25
etc.

3. Take one jelly bean of each color and write it as a fraction:
1 R = 1/8
1 Y = 1/6
1 B = 1/25

4. Take two jelly beans of each color and write it as a fraction:
2 R = 2/8
2 Y = 2/6
2 B = 2/25

5. Continue in this manner until everyone understands the part/whole relationship.

## ACTIVITY 9: MORE FRACTION ACTION

One of the problems students often have is understanding how to perform arithmetic operations with unlike fractions. Many times the student simply adds the numerators and adds the denominators. The following activity may help unravel some of that mental tangle. It also raises some interesting side issues on exactness when applying concepts to the concrete world. For instance, how accurately can you chop jelly beans into pieces? Not very! Therefore, it might be best to do this activity theoretically. Students should be ready for it.

Question How can you add a red (R) and a yellow (Y) jelly bean?

Procedure 1. Assume you can chop each of the 8 R's into 3 equal pieces.

3 x 8 = 24 pieces in R.

Question Into how many pieces must you chop each of the 6 Y's to obtain 24 pieces?

Procedure 2. If you chop each Y into 4 pieces, then

4 x 6 = 24 pieces in Y.

Now that each group has the same number of equal pieces, the pieces can be added:

1 R = 1/8 = 3/24
1 Y = 1/6 = 4/24

Therefore, 1/8 + 1/6 = 7/24.

Have students continue in this theoretical fashion for all possible combinations of colors.

Eat one jelly bean of each color and go on to the next page.

## ACTIVITY 10: DIMINISHING RETURNS

Now that your students have eaten one jelly bean from each color group, ask them to examine what has happened to each group. The whole has diminished by the number of colors, and each color group has been diminished by one. Therefore, each group must be renamed mathematically. For example, because

R now = 7, 1 R = 1/7

**and because**

Y now = 5, 1 Y = 1/5.

All the definitions of whole groups have changed, and the mathematical problems have also changed. Have students practice a few problems in the same way as they did in the preceding activity. Emphasize that any thing or group of things considered as a whole is equal to 1 and all parts are a fraction of that whole. The wonderful number 1 has infinite flexibility.

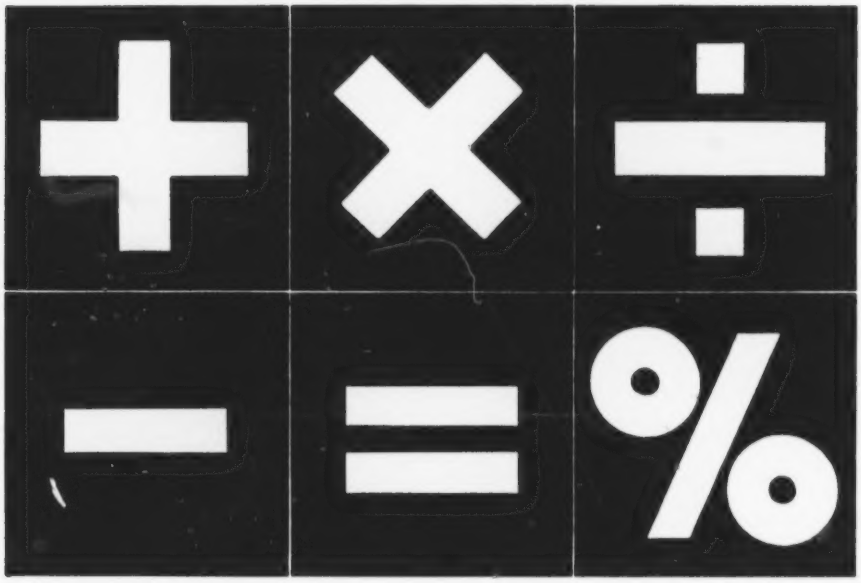
Now have students eat another jelly bean from each group. What are the consequences? Another set of brand new problems!

When students tire of eating and calculating, have them count the number of jelly beans left. What fraction of the original number are left? What fraction was eaten?

A final problem: Ask students how they can distribute the remaining jelly beans equitably. By random selection? By having each person choose one at a time? By number and by color? By a competition? Promote as many possibilities as possible.

Now, distribute and eat the rest of the jelly beans.

# HOW TO MAKE MATH MAGIC!
# ORGANIZATIONAL QUESTIONS



**Math is fun!**

# INTRODUCTION

If you feel that you have a population of math-anxious students in your class, you can implement an anxiety-reduction program in a variety of ways. The suggestions for a smooth and successful program, as outlined on the following pages, come from the Ohio State University project experience. The need to bridge the gap between the theoretical plan and implementation in public school settings was as important as the effort to bridge the gap for math-anxious students between concrete and abstract thinking.

## STEP 1: SUPPORT

A key ingredient to the success of any program is gaining the interest, enthusiasm, and backing of the Top Dog, the Head Honcho, the Boss. Such backing does much to inspire faculty members to show interest, enthusiasm, and support for the program. This faculty backing does much to generate student interest and enthusiasm. Student interest generates parental interest and support. Sell the program to the ones who count . . . administrators, faculty, students, and parents.

## STEP 2: ORGANIZATION

1. Who's going to need the program? In identifying participants, don't overlook the high achievers. Many of them are the most math anxious. However, you might want to have different levels of the program, depending on the achievement of the students.

2. When is the training going to take place? Will it be an in-school or after-school activity? What time of the year will you offer it? Long breaks because of holidays or exams can destroy momentum.

3. Will you offer the program more than once a year? How long will each program last? How many sessions for how many weeks? Our experience over a six-week period was that twelve sessions were too few. Students absences and scheduling conflicts will always cut into your best-laid plans. We did find, though, that one class period is a convenient length of time for a session.

4. Where will you meet? Try to have a location that is away from the gym and music rooms and the aromas of the cafeteria or the noise of the front office. We found that instructors were most comfortable in small, seminar-type conference rooms such as those adjacent to a library or a guidance office. Since some of the self-instructional activities require concentration, quiet, and intense listening, a private, sound resistant spot is most desirable.

5. How many students will be in each group? We recommend a group size of six students, but four lively or eight restrained students could also work together effectively.

6. Will your program include self-instructional techniques only, math exploration only, or a combination of both?

7. Who will lead the groups? Don't limit your instructors to those skilled in math. In fact, some of the best communicators may be persons willing to work through their own math attitudes. Be sure that the instructor has a sense of adventure and a willingness to throw away old approaches to life, students, and mathematics.

8. Who will train the instructors? You need one person skilled in counseling and another skilled in math or someone with talents in both areas.

9. What materials will you need? List them, and then beg, borrow, or buy them.

## STEP 3: FINAL CONSIDERATIONS

### THOSE SMALL DETAILS THAT CAN MAKE OR BREAK YOUR PROGRAM

Provide Food.
Students truly become anxious, and food is one of the best calming agents and/or motivators. Food provided will always be eaten faster than you thought possible. And students' friends will gather longingly by the door hoping for a handout.

Check out the space you finally finagle from the scheduler.
Are there electric outlets where you need them, a chalkboard, a bulletin board and tacks, chalk and erasers, a table, enough chairs? Do you need a key to get into this room, or will you spend the first ten minutes of each session trying to get into this room?

Develop a system for checking attendance and the daily calendar.
This is important if you don't want to be delayed by fruitless searches for absentees. Know how to use other personnel to locate students who are in the building. Rounding up students who forget to come has lost many an instructor several pounds as well as valuable time chasing about the halls of a large school building.

Get a good parking space.
Where will you park if you are not a regular member of the school staff? Seems trivial? Taking a staff member's parking spot is the quickest way to undermine faculty support of your efforts. However, many an instructor has lost valuable time walking several blocks from the nearest street-parking spot. Check with the office and arrange for the best possible parking place.

Know school procedures.
Do you need to check in at the office when you arrive? Many an instructor has been startled and delayed by security-conscious school personnel who subtly try to determine if the person is up to no good.

Allow more time.
Planning, setting up, and implementing projects often take more time and effort than you think you will need. The Ohio State University Math Anxiety Project Law says:

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